

# CHAPTER 11

## Cost–volume– profit analysis for decision making

### CONTENTS

- 11.1 Cost behaviour analysis using high–low method
- 11.2 Absorption costing versus direct costing
- 11.3 CVP analysis
- 11.4 Impact of change with CVP analysis
- 11.5 Contribution margin variance analysis

## ADDITIONAL PROBLEMS

### Problem 11.1

Cost behaviour analysis using high–low method

Embleton Furniture Ltd has experienced different levels of factory overhead cost in relation to machine hours during recent years. The costs at the high and low activity levels during the past 4 years are as follows.

	Level of activity	
	High	Low
Factory overhead	\$644 000	\$564 000
Machine hours	55 000	35 000

The factory overhead consists of four items: indirect materials, maintenance, depreciation and electric power. The company has analysed these costs at the high level of activity and determined that costs are incurred at that level as follows:

Indirect materials (variable)	\$ 55 000
Maintenance (mixed)	164 000
Depreciation (fixed)	304 000
Power (variable)	121 000
Total	<u>\$644 000</u>

**Required:**

- A. Establish the cost function ( $y = a + bx$ ) for total factory overhead.
- B. If machine hours of 51 000 are expected for the next year, what is the estimate for total overhead?
- C. Calculate how much of the total factory overhead is maintenance cost at the low activity level of 35 000 machine hours.

### Solution

#### EMBLETON FURNITURE LTD

A.

$$b = \frac{\$644\,000 - \$564\,000}{55\,000 - 35\,000} = \frac{\$80\,000}{20\,000} = \$4$$

$$a = 644\,000 - 4(55\,000) = \$424\,000$$

$$y = 424\,000 + 4X$$

B.

$$y = 424\,000 + 4(51\,000) = \$628\,000$$

C.

Indirect materials (variable) =  $\$55\,000 / 55\,000 = \$1$  per Machine hr

Power (variable) =  $\$121\,000 / 55\,000 = \$2.20$  per Machine hr

Factory overhead at low level	\$564 000
Indirect materials \$1(35 000)	\$35 000
Power: \$2.20(35 000)	77 000
Depreciation (fixed)	304 000
Maintenance (1)	<u>148 000</u>
	<u>\$564 000</u>

$$(1) \$564\,000 - (35\,000 + 77\,000 + 304\,000) = \$148\,000$$



### Problem 11.2 Absorption costing versus direct costing

Benara Biscuits Pty Ltd prepares statements of financial performance under absorption costing for external reporting purposes, but uses direct costing for management purposes. The annual fixed factory overhead cost of \$168 000 is applied to the units of production on the basis of actual production for that year. The company's only product has a contribution margin of 40%, and the selling and administrative expense is a mixed cost. The statements of financial performance, under absorption costing, for the past 3 years are as follows:

	2000	2001	2002
Sales	\$960 000	\$960 000	\$720 000
Beginning inventory	—	104 000	108 000
Cost of goods manufactured	728 000	648 000	488 000
Ending inventory	104 000	108 000	61 000
Cost of goods sold	624 000	644 000	535 000
GROSS PROFIT	336 000	316 000	185 000
Selling and administrative expenses	184 000	184 000	160 000
NET PROFIT	\$152 000	\$132 000	\$25 000

The company's unit sales and production data for the past 3 years are:

	2000	2001	2002
Sales	24 000	24 000	18 000
Production	28 000	24 000	16 000

**Required:**

- Determine the fixed factory overhead rate for each year.
- Calculate the variable selling and administrative expense per unit sold.
- Prepare statements of financial performance for the 3 years using the direct costing method.
- Reconcile the difference between the net profits using absorption costing and using direct costing for each of the 3 years.

## Solution

### BENARA BISCUITS PTY LTD

See note 1.

A.

Fixed factory overhead rates:

2000:  $\$168\,000/28\,000 = \$6.00$  per unit

2001:  $\$168\,000/24\,000 = \$7.00$  per unit (see Note 1)

2002:  $\$168\,000/16\,000 = \$10.50$  per unit

B.

Variable selling and administrative expense per unit sold (b):

$$b = \frac{\$184\,000 - \$160\,000}{24\,000 - 18\,000} = \frac{\$24\,000}{6\,000} = \$4.00 \text{ per unit sold}$$

C.

Variable manufacturing costs per unit:

$$(\$728\,000 - \$168\,000)/28\,000 = \$20 \text{ per unit}$$

### Direct Costing Statements of Financial Performance For the years 2000, 2001 and 2002

		2000	2001	2002
Sales		<u>\$960 000</u>	<u>\$960 000</u>	<u>\$720 000</u>
Variable cost of goods sold	480 000	480 000	360 000	
Variable S and A expenses	<u>96 000</u>	<u>96 000</u>	<u>72 000</u>	
Contribution margin	<u>384 000</u>	<u>384 000</u>	<u>288 000</u>	
Fixed costs:				
Manufacturing	168 000	168 000	168 000	
Selling and admin	<u>88 000</u>	<u>88 000</u>	<u>88 000</u>	
	<u>256 000</u>	<u>256 000</u>	<u>256 000</u>	
Net profit	<u>\$128 000</u>	<u>\$128 000</u>	<u>\$32 000</u>	

D.

Reconciliation AC net profit and DC net profit:

	2000	2001	2002
DC net profit	\$128 000	\$128 000	\$32 000
- AC fixed cost	<u>-</u>	<u>24 000</u>	<u>28 000</u>
	128 000	104 000	4 000
+ Fixed cost E/Inv AC (1)	<u>24 000</u>	<u>28 000</u>	<u>21 000</u>
AC Net Profit	<u>\$152 000</u>	<u>\$132 000</u>	<u>\$25 000</u>
 (1) Fixed costs E/inv	 \$6(4 000)	 \$7 (4 000)	 \$10.50 (2 000)

Note: 1.2001 production must be 24 000 units not the 21 000 units given.

	2001
Cost of goods manufactured:	\$648 000
VC 24 000 x 20	480 000
FC	168 000
	<u>\$648 000</u>

With 2001 production at 21 000 units Benara cannot sell 18 000 units in 2002.

	2000	2001	2002
B/Inv	-	4 000	1 000
Production	<u>28 000</u>	<u>21 000</u>	<u>16 000</u>
Available	28 000	25 000	17 000
Sales	<u>24 000</u>	<u>24 000</u>	<u>18 000</u>
E/Inv	<u>4 000</u>	<u>1 000</u>	<u>(1 000)</u>

Inventory deficiency of 1 000 units.

**Problem 11.3** CVP analysis

Kewdale Pty Ltd has provided the following unit production and sales information for its only product:

Direct materials	10 kg at \$3 per kg
Direct labour	6 hours at \$7 per hour
Variable factory overhead	6 hours at \$3 per hour
Sales commissions	\$6 per unit
Selling price	\$120

Only one product is produced. The annual fixed costs are \$960 000.

**Required:**

- Calculate the break-even point.
- If the company wants to attain a before-tax profit of \$96 000, calculate the number of units the company must sell to reach its goal. What is the margin of safety at this sales level?
- The company is considering two schemes: (1) sell 42 000 units with a retail price of \$120 each, or (2) sell 40 000 units at \$124 each. Which scheme will provide the higher net profit?
- If the company increases fixed costs by \$120 000, what level of dollar sales must be attained to earn a before-tax profit of \$96 000? Assume the sales price and variable costs per unit will not change.
- If the company's tax rate is 40%, how much additional fixed costs can the company incur at a sales level of 46 000 units and still maintain an after-tax net profit of \$96 000?

**Solution**

## KEWDALE PTY LTD

A.

$$\begin{aligned} VC &= \$96 \\ CM &= \$24 \\ CM\% &= 20\% \end{aligned}$$

$$\begin{aligned} \text{Breakeven point (units)} &= \$960\,000 / \$24 = 40\,000 \text{ units} \\ \text{Breakeven point (dollars)} &= \$960\,000 / 0.20 = \$4\,800\,000 \\ \text{Check; } 40\,000 (\$120) &= \$4\,800\,000 \end{aligned}$$

B.

$$\begin{aligned} \text{Breakeven point} + \text{DNPBT} &= (\$960\,000 + \$96\,000) / \$24 = 44\,000 \text{ units} \\ \text{Margin of safety} &= 44\,000 - 40\,000 = 4\,000 \text{ units} \end{aligned}$$

C.

$$\begin{aligned} 1. \text{ CM} &= \$120 - \$96 = \$24 \\ \text{Total CM} &= \$24(42\,000) = \$1\,008\,000 \\ 2. \text{ CM} &= \$124 - \$96 = \$28 \\ \text{Total CM} &= \$28(40\,000) = \$1\,120\,000 \end{aligned}$$

Therefore sell 40 000 units at \$124.

D.

$$\begin{aligned} \text{Breakeven } \$\$ + \text{DNPBT} &= (\$1\,080\,000 + 96\,000) / 0.20 \\ &= \$1\,176\,000 / 0.20 = \$5\,880\,000 \end{aligned}$$

E.

$$\begin{aligned} \text{Before tax net profit: } \$96\,000 / (1 - 0.40) &= \$160\,000 \\ 46\,000 &= (\text{FC} + \$160\,000) / \$24 \\ 24(46\,000) &= \text{FC} + 160\,000 \\ \text{FC} &= 1\,104\,000 - 160\,000 \\ &= \$944\,000 \end{aligned}$$

$$\begin{aligned} \text{Fixed costs must decrease by:} \\ \$960\,000 - \$944\,000 &= \$16\,000 \end{aligned}$$

**Problem 11.4** Impact of change with CVP analysis

Lawley Ltd has prepared the following draft profit and loss analysis for the current year.

Sales (13 000 units)	\$520 000
Variable expenses	299 000
Contribution margin	<u>221 000</u>
Fixed expenses	92 400
Net profit	<u>\$128 600</u>

**Required:**

Answer each of the following four independent situations:

1. If the company's manager is considering increasing his salary by \$40 800, how much must dollar sales increase to maintain the company's current net profit?
2. If the company decreases sales commissions, variable expenses would decrease by 10%. The company believes that unit sales would decrease 5% due to the loss of sales representatives, even though the company plans to increase its advertising budget by \$20 000. Should the company decrease the sales commissions?
3. If the company changes its production and marketing techniques, it is projected that variable expenses will increase 10%, fixed expenses will decrease 15% and sales will increase 20%. Calculate the company's break-even point in terms of sales dollars if the new strategy is adopted. Assume that the sales price per unit would not be changed. Round your answer to the nearest dollar.
4. If the company's net profit increases 250% next year due to a 28% increase in sales, would performance be better or worse than expected? Assume adequate capacity exists to meet the increased volume without increasing fixed costs.

**Solution**

## LAWLEY LTD

SP per unit \$520 000/13 000 =	\$40.00 per unit
Variable expenses per unit \$299 000/13 000 =	<u>23.00</u> per unit
CM per unit	<u>\$17.00</u>
CM ratio \$17/\$40	42.5%

1. Dollar sales to absorb increase in company manager's salary.

$$\$40\,800/0.425 = \$96\,000$$

2. Variable expenses per unit: 0.9 (23) = \$20.70

CM: \$40 – \$20.70 =	\$19.30
Unit sales 0.95 (13 000)	<u>\$ 12 350</u>
Total CM (new)	\$238 355
Prior total CM \$17 (13 000)	<u>221 000</u>
Incremental CM	17 355
Incremental advertising exp	<u>20 000</u>
Differential loss	(\$ 2 645)

The company should not decrease sales commissions and increase advertising.

3. Variable expenses 1.10(\$23) = \$25.30  
Fixed expenses 0.85(\$92 400) = \$78 540  
CM ratio (\$40.00 – \$25.30)/\$40 = 36.75%  
Breakeven \$\$ = \$78 540/0.3675 = \$213 714

4. Net profit next year 3.50(28 600) = \$100 100  
Sales next year 1.28(520 000) = 665 600  
Net profit % 15.04%

This year:

$$\text{Net profit \% } \$28\,600/\$520\,000 = \underline{5.5\%}$$

Performance would be better next year.



### Problem 11.5 Contribution margin variance analysis

The sales manager of Claremont Pty Ltd cannot understand the contribution margin results shown on the most recent quarterly statement. She had been monitoring sales volume carefully during the quarter and knew that it was substantially above the amount budgeted. However, the actual contribution margin earned was less than the amount budgeted. The sales manager has asked for your help in interpreting the results. The company only sells one product, and a summary of the statement of financial performance results is as follows:

	Budget	Actual
Sales – units	21 000	23 200
Sales – dollars	\$840 000	\$881 600
Variable costs	504 000	696 000
Contribution margin	<u>\$336 000</u>	<u>\$185 600</u>

#### Required:

Determine why the actual contribution margin was so much less than the amount budgeted by calculating the variances that caused the variation.

### Solution

#### CLAREMONT PTY LTD

Sales price variance:

Actual unit sales  $\times$  selling price differential

$23\,200 \times (\$2.00) = \$46\,400$  unfavourable

Sales volume variance:

Budgeted CM  $\times$  unit sales differential

$\$16.00 \times 2\,200 = \$35\,200$  favourable

Variable cost variance:

Actual unit sales  $\times$  variable cost differential

$23\,200 \times \$6.00 = \$139\,200$  unfavourable

Unfavourable CM variance \$150 400 U

Variances \$ 46 400 U

\$ 35 200 F

\$139 200 U

\$150 400 U

Calculations:

		Budget	Actual
Selling price	\$840 000/21 000	\$40.00	
	881 6700/23 200		\$38.00
VC per unit	504 000/21 000	24.00	
	696 000/23 200		30.00
CM per unit	\$40 – \$24	16.00	
	\$38 – \$30		8.00